

WHAT IS CLAIMED IS:

1 1. A monodisperse population of nanocrystals comprising:
2 a plurality of nanocrystal particles, wherein each particle includes a core including a
3 first semiconductor material and an overcoating including a second semiconductor material
4 uniformly deposited on the core, wherein the first semiconductor material and the second
5 semiconductor material are the same or different,
6 wherein the monodisperse population emits light in a spectral range of no greater than
7 about 60 nm full width at half max (FWHM) when irradiated.

1 2. The monodisperse population of claim 1, wherein the monodisperse
2 population emits light in a spectral range of no greater than about 40 nm full width at half
3 max (FWHM) when irradiated.

1 3. The monodisperse population of claim 1, wherein the monodisperse
2 population emits light in a spectral range of no greater than about 30 nm full width at half
3 max (FWHM) when irradiated.

1 4. The monodisperse population of claim 1, wherein the monodisperse
2 population exhibits photoluminescence having a quantum yield of greater than 30%.

1 5. The monodisperse population of claim 4, wherein the monodisperse
2 population exhibits photoluminescence having a quantum yield of greater than 40%.

1 6. The monodisperse population of claim 1, wherein the spectral range has a
2 peak in the range of about 470 nm to about 620 nm.

1 7. The monodisperse population of claim 1, wherein the cores of the plurality of
2 nanocrystal particles have diameters having no greater than 10% rms deviation.

1 8. The monodisperse population of claim 7, wherein the cores of the plurality of
2 nanocrystal particles have diameters having no greater than 5% rms deviation.

1 9. The monodisperse population of claim 7, wherein the cores have a mean
2 diameter in the range of about 20 Å to about 125 Å.

1 10. The monodisperse population of claim 1, wherein the overcoating includes
2 greater than 0 to about 5.3 monolayers of the second semiconductor material.

1 11. The monodisperse population of claim 10, wherein the second semiconductor
2 material is ZnS or ZnSe.

1 12. The monodisperse population of claim 10, wherein the overcoating includes
2 less than about one monolayer of the second semiconductor material.

1 13. The monodisperse population of claim 10, wherein the overcoating includes in
2 the range of about one to about two monolayers of the second semiconductor material.

1 14. The monodisperse population of claim 1, wherein each particle of the
2 monodisperse particle population further comprises an organic layer on the outer surface of
3 the particle.

1 15. The monodisperse population of claim 14, wherein the organic layer includes
2 a moiety selected to provide a stable suspension or dispersion with a suspension or dispersion
3 medium.

1 16. The monodisperse population of claim 14, wherein the organic layer includes
2 a moiety selected to exhibit affinity for a surface of the nanocrystal particle.

1 17. The monodisperse population of claim 16, wherein the moiety includes a
2 short-chain polymer terminating in a moiety having affinity for a suspension or dispersion
3 medium.

1 18. The monodisperse population of claim 1, wherein the first semiconductor
2 material is selected from the group consisting of CdS, CdSe, CdTe, and mixtures thereof.

1 19. The monodisperse population of claim 18, wherein the second semiconductor
2 material is selected from the group consisting of ZnS, ZnSe, CdS, CdSe, and mixtures
3 thereof.

1 20. The monodisperse population of claim 1, wherein the second semiconductor
2 material is selected from the group consisting of ZnS, ZnSe, CdS, CdSe, and mixtures
3 thereof.

1 21. The monodisperse population of claim 1, wherein the first semiconductor
2 material is CdSe and the second semiconductor material is ZnS.

1 22. The monodisperse population of claim 21, wherein the overcoating includes
2 greater than 0 to about 5.3 monolayers of the second semiconductor material.

1 23. The monodisperse population of claim 21, wherein the overcoating includes
2 less than about one monolayer of the second semiconductor material.

1 24. The monodisperse population of claim 21, wherein the overcoating includes
2 about one to about two monolayers of the second semiconductor material.

1 25. A suspension of nanocrystals comprising:
2 a plurality of nanocrystal particles, wherein each particle includes a core including a
3 first semiconductor material, and an overcoating including a second semiconductor material
4 uniformly deposited on the core, wherein the first semiconductor material and the second
5 semiconductor material are the same or different,
6 wherein the cores of the plurality of nanocrystal particles have diameters having no
7 greater than 10% rms deviation.

1 26. The suspension of claim 25, wherein the rms deviation is no greater than 5%.

1 27. The suspension of claim 25, wherein the cores have a mean diameter in the
2 range of about 20 Å to about 125 Å.

1 28. The suspension of claim 25, wherein the overcoating includes greater than 0
2 to about 5.3 monolayers of the second semiconductor material.

1 29. The suspension of claim 28, wherein the second semiconductor material is
2 ZnS or ZnSe.

1 30. The suspension of claim 28, wherein the overcoating includes less than about
2 one monolayer of the second semiconductor material.

1 31. The suspension of claim 28, wherein the overcoating includes about one to
2 about two monolayers of the second semiconductor material.

1 32. The suspension of claim 25, wherein each particle of the monodisperse
2 particle population further comprises an organic layer on the outer surface of the particle.

1 33. The suspension of claim 32, wherein the organic layer includes a moiety
2 selected to provide a stable suspension or dispersion with a suspension or dispersion medium.

1 34. The suspension of claim 32, wherein the organic layer includes a moiety
2 selected to exhibit affinity a surface of a nanocrystal.

1 35. The suspension of claim 34, wherein the moiety includes a short-chain
2 polymer terminating in a moiety having affinity for a suspension or dispersion medium.

1 36. The suspension of claim 25, wherein the first semiconductor material is
2 selected from the group consisting of CdS, CdSe, CdTe, and mixtures thereof.

1 37. The suspension of claim 36, wherein the second semiconductor material is
2 selected from the group consisting of ZnS, ZnSe, CdS, CdSe, and mixtures thereof.

1 38. The suspension of claim 25, wherein the second semiconductor material is
2 selected from the group consisting of ZnS, ZnSe, CdS, CdSe, and mixtures thereof.

1 39. The monodisperse population of claim 25, wherein the first semiconductor
2 material is CdSe and the second semiconductor material is ZnS.

1 40. The suspension of claim 39, wherein the overcoating includes greater than 0
2 to about 5.3 monolayers of the second semiconductor material.

1 41. The suspension of claim 39, wherein the overcoating includes less than about
2 one monolayer of the second semiconductor material.

1 42. The suspension of claim 39, wherein the overcoating includes about one to
2 about two monolayers of the second semiconductor material.

1 43. A method of preparing a monodisperse population of nanocrystals capable of
2 light emission, comprising:
3 introducing into a coordinating solvent a plurality of cores, each core including a first
4 semiconductor material, and a precursor capable of thermal conversion into a second
5 semiconductor material, the cores emitting light in a spectral range of no greater than about
6 60 nm full width half max (FWHM) when irradiated,
7 wherein the coordinating solvent is maintained at a temperature sufficient to convert
8 the precursor into the second semiconductor material yet insufficient to substantially alter the
9 monodispersity of the cores,
10 wherein the second semiconductor material has a band gap greater than the first
11 semiconductor material, and
12 whereby the cores become individually overcoated with the second semiconductor
13 material to form a monodisperse population of nanocrystals.

1 44. The method of claim 43, further comprising monitoring the monodispersity of
2 the population of nanocrystals.

1 45. The method of claim 44, further comprising increasing the temperature of the
2 coordinating solvent when monitoring indicates overcoating appears to stop.

1 46. The method of claim 44, further comprising lowering the temperature of the
2 coordinating solvent when monitoring indicates a spreading of the size distribution of the
3 population of nanocrystals.

1 47. The method of claim 43, wherein the first semiconductor material is selected
2 from the group consisting of CdS, CdSe, CdTe, and mixtures thereof.

1 48. The method of claim 43, wherein the second semiconductor material is
2 selected from the group consisting of ZnS, ZnSe, CdS, CdSe and mixtures thereof.

1 49. The method of claim 43, wherein the cores have a mean diameter in the range
2 of about 20 Å to about 125 Å.

1 50. The method of claim 43, further comprising exposing the monodisperse
2 population of nanocrystals to an organic compound having affinity for a surface of a
3 nanocrystal, whereby the organic compound displaces the coordinating solvent.

1 51. The method of claim 43, wherein the spectral range is no greater than about
2 40 nm full width at half max (FWHM).

1 52. The method of claim 43, wherein the population of nanocrystals exhibit
2 photoluminescence having a quantum yield of greater than about 30%.

1 53. A method of preparing a monodisperse population of nanocrystals capable of
2 light emission, comprising:

3 introducing into a coordinating solvent a plurality of cores, each core including a first
4 semiconductor material, and a precursor capable of thermal conversion into a second
5 semiconductor material, the plurality of cores having diameters having no greater than 10%
6 rms deviation,

7 wherein the coordinating solvent is maintained at a temperature sufficient to convert
8 the precursor into the second semiconductor material yet insufficient to substantially alter the

9 dispersity of the cores,
10 wherein the second semiconductor material has a band gap greater than the first
11 semiconductor material, and
12 whereby the cores become individually overcoated with the second semiconductor
13 material to form a monodisperse population of nanocrystals.

1 54. The method of claim 53, further comprising monitoring the monodispersity of
2 the population of nanocrystals.

1 55. The method of claim 53, wherein the first semiconductor material is selected
2 from the group consisting of CdS, CdSe, CdTe, and mixtures thereof.

1 56. The method of claim 53, wherein the second semiconductor material is
2 selected from the group consisting of ZnS, ZnSe, CdS, CdSe and mixtures thereof.

1 57. The method of claim 53, wherein the cores have a mean diameter in the range
2 of about 20 Å to about 125 Å.

1 58. The method of claim 53, further comprising exposing the monodisperse
2 population of nanocrystals to an organic compound having affinity for a surface of a
3 nanocrystal, whereby the organic compound displaces the coordinating solvent.

1 59. The method of claim 53, wherein the cores, when irradiated, emit light in a
2 spectral range of no greater than about 60 nm full width half maximum (FWHM).

1 60. A method of preparing a monodisperse population of nanocrystals capable of
2 light emission, comprising:

3 contacting a plurality of cores, each core including a first semiconductor material,
4 with a precursor capable of thermal conversion into a second semiconductor material in a
5 coordinating solvent, the plurality of cores having diameters having no greater than 10%
6 rms deviation, and

7 overcoating each core individually with a second semiconductor material without
8 substantially altering the monodispersity of the cores.

1 61. A family of nanocrystal dispersions comprising:
2 a first suspension or dispersion of nanocrystals, wherein each nanocrystal in the first
3 suspension or dispersion includes a core including a first semiconductor material and an
4 overcoating including a second semiconductor material uniformly deposited on the core; and
5 a second suspension or dispersion of nanocrystals, wherein each nanocrystal in the
6 second suspension or dispersion includes a core including a third semiconductor material and
7 an overcoating including a fourth semiconductor material uniformly deposited on the core,
8 wherein the first, second, third and fourth semiconductor materials are each,
9 individually, the same or different,
10 wherein the first suspension or dispersion, when irradiated, emits light in a spectral
11 range of no greater than about 60 nm full width at half max (FWHM), the light having a first
12 maximum wavelength of light emission.

1 62. The family of claim 61, wherein the second suspension or dispersion, when
2 irradiated, emits light having a second maximum wavelength of light emission, the first
3 maximum wavelength and the second maximum wavelength being different.

1 63. The family of claim 62, further comprising a third suspension or dispersion of
2 nanocrystals having a third maximum wavelength of light emission different from the first
3 maximum wavelength and the second maximum wavelength.

1 64. The family of claim 63, further comprising a fourth suspension or dispersion
2 of nanocrystals having a fourth maximum wavelength of light emission different from the
3 first maximum wavelength, the second maximum wavelength, and the third maximum
4 wavelength.

1 65. The family of claim 64, further comprising a fifth suspension or dispersion of
2 nanocrystals having a fifth maximum wavelength of light emission different from the first

3 maximum wavelength, the second maximum wavelength, the third maximum wavelength,
4 and the fourth maximum wavelength.

1 66. The family of claim 65, further comprising a sixth suspension or dispersion of
2 nanocrystals having a sixth maximum wavelength of light emission different from the first
3 maximum wavelength, the second maximum wavelength, the third maximum wavelength,
4 the fourth maximum wavelength, and the fifth maximum wavelength.

1 67. The family of claim 62, wherein each maximum wavelength of light emission
2 of the first suspension or dispersion and the second suspension or dispersion is between 470
3 nm and 620 nm.

1 68. A method of making a family of nanocrystal dispersions comprising:
2 overcoating a first monodisperse population of nanocrystal cores; and
3 overcoating a second monodisperse population of nanocrystal cores,
4 wherein each monodisperse population of nanocrystal cores, when irradiated, emits
5 light in a spectral range of no greater than about 60 nm full width half max (FWHM), and
6 wherein the first monodisperse population of cores has a maximum wavelength of light
7 emission different from a maximum wavelength of light emission of the second
8 monodisperse population.

1 69. The method of claim 68, wherein the maximum wavelengths of light emission
2 of the first monodisperse population and the second monodisperse population differ by at
3 least 30 nm.